

THE EFFECTS OF HANDWRITING, SPELLING, AND T-UNITS ON HOLISTIC
SCORING WITH IMPLICATIONS FOR DYSGRAPHIA

A Dissertation

by

REGINA GAY HOOTEN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2009

Major Subject: Curriculum and Instruction

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ABSTRACT

The Effects of Handwriting, Spelling, and T-units on Holistic Scoring with Implications
for Dysgraphia. (December 2009)

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This study examined the relationship of holistic scoring with handwriting legibility, spelling accuracy and number of T-units within compositions written by children in grades 3 through 6 using path analysis. A sample of 223 compositions was rated for handwriting legibility and composition quality, and coded for number of T-units and percentage of accurately spelled words. Number of T-units was consistently the strongest predictor of holistic scoring across the four grade levels. Handwriting legibility and spelling accuracy yielded varying results in different grade levels.

DEDICATION

To my youngest son, who inspired me to find an answer

To my husband, who I love dearly

To my father, who is a life-long learner

ACKNOWLEDGEMENTS

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I especially want to thank my loving husband, who patiently and caringly supported my continuing education endeavors and looks forward to my graduation.

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TABLE OF CONTENTS

	Page
ABSTRACT	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vii
LIST OF FIGURES	viii
LIST OF TABLES	ix
CHAPTER	
I INTRODUCTION: THE IMPORTANCE OF HANDWRITING	1
Motivation for the Study	1
The Importance of Handwriting	2
Relevance to Education	2
Dysgraphia Defined.....	3
More Research Is Needed	6
Purpose	7
Research Questions	7
II REVIEW OF LITERATURE.....	8
Handwriting.....	8
Handwriting and Spelling.....	10
Handwriting and T-units	12
Handwriting and Holistic Scoring.....	13
III METHOD.....	15
Participants	15
Procedure.....	16
Handwriting and Holistic Scoring.....	17
Spelling.....	18

CHAPTER	Page
T-Units	18
Data Analysis	19
IV RESULTS.....	21
Third Grade	21
Fourth Grade	23
Fifth Grade.	25
Sixth Grade.....	26
V DISCUSSION AND CONCLUSION.....	29
Handwriting to Spelling... ..	30
Handwriting and Spelling and T-units	31
Predicting Holistic Scores	32
Limitation of This Study	33
Conclusion.....	34
Implications.....	34
REFERENCES	36
APPENDIX A	47
APPENDIX B	48
VITA	49

LIST OF FIGURES

	Page
Figure 1 Path model for testing dysgraphia	20
Figure 2 Path model for grade 3	22
Figure 3 Path model for grade 4	24
Figure 4 Path model for grade 5	26
Figure 5 Path model for grade 6	27

LIST OF TABLES

	Page
Table 1 Means and standard deviations for holistic score, handwriting score, T-units, and spelling in grade 3 essays (N = 38)	22
Table 2 Bivariate correlations of holistic scoring, handwriting scoring, T-units, and spelling for grade 3 essays.....	22
Table 3 Effect coefficients for predictors in path model for grade 3	23
Table 4 Means and standard deviations for holistic score, handwriting score, T-units, and spelling in grade 4 essays (N = 48)	23
Table 5 Bivariate correlations of holistic scoring, handwriting scoring, T-units, and spelling for grade 4 essays.....	24
Table 6 Effect coefficients for predictors in path model for grade 4	24
Table 7 Means and standard deviations for holistic score, handwriting score, T-units, and spelling in grade 5 essays (N = 97)	25
Table 8 Bivariate correlations of holistic scoring, handwriting scoring, T-units, and spelling for grade 5 essays.....	25
Table 9 Effect coefficients for predictors in path model for grade 5	26
Table 10 Means and standard deviations for holistic score, handwriting score, T-units, and spelling in grade 6 essays (N = 40)	27
Table 11 Bivariate correlations of holistic scoring, handwriting scoring, T-units, and spelling for grade 6 essays	27
Table 12 Effect coefficients for predictors in path model for grade 6	28
Table 13 Effect coefficients by path and grade level	30

CHAPTER I
INTRODUCTION: THE IMPORTANCE
OF HANDWRITING

Motivation for the Study

I noticed as early as kindergarten that there was something different about my younger son. When he used crayons to color a picture, he scribbled over the picture regardless of the lines. In first grade, he was spatially challenged to write on a line or in a square. After battles of redoing his homework in the early elementary grades in hopes of correcting his poor handwriting, I began to realize that the struggle for better handwriting was turning me and my child into emotional monsters. The issue wasn't that my son was a slow learner -- he was very bright -- the issue was that he had sloppy handwriting which affected the appearance of his work. Unfortunately, as he got older, I noticed his poor handwriting influenced the quality of his writing. In fourth grade, he failed the writing portion of the Texas Assessment and Skills Test. In sixth grade, even though he read above grade level, he was identified as dyslexic based on his testing performance on two measures: spelling and misreading of non-words. In his adolescent years, my son had to develop an understanding of his strengths and weaknesses, and how to compensate and accommodate his handwriting disability. Even today, his writing still suffers in the areas of handwriting, spelling, and written expression.

This dissertation follows the style of *Reading and Writing: An Interdisciplinary Journal*.

The Importance of Handwriting

Developing legibility and fluency in handwriting saves time for both the teacher, who spends less time deciphering the writing, and the student, who completes written assignments in less time and produces an attractive product. In most school districts formal training in handwriting appears to be limited to the first three or four grades. Hamstra-Bletz and Blöte (1993) suggested that some poor handwriting may be caused by students' not having had enough training to form letters automatically when rapid writing is needed as a tool to perform assigned writing tasks. The importance of handwriting is the perception it leaves with others by its appearance. In the Graham and Harris study (2005), 169 first through third grade teachers responded through a survey the perception that handwriting had a negative impact on how much a student wrote (75%), the quality of their writing (66%), grades on written products (57%) and the time needed to complete assignments (80%).

Relevance to Education

Essay writing has become a tool for measuring student aptitude and learning at the state level and in post-secondary education. Thirty-three states have essay writing as one of their accountability tests in the public education system. In Texas, students are required to take four high stakes writing tests before leaving public school (Grades 4, 7, 10, 11). Following the American College Test (ACT) lead, the College Board Scholastic Aptitude Test (SAT) added a mandatory 20- minute essay to their test in 2005. In fact, every major graduate school test (e.g. GRE, GMAT, MCAT, LSAT) incorporates essay

writing (Camara 2005). When it comes to high-stakes writing tests, children with handwriting and composing difficulties may be at a disadvantage.

Dysgraphia Defined

Dysgraphia at this time is a generic prognosis for a handwriting disability. In Colman's Oxford Dictionary of Psychology (2003) dysgraphia is defined as

the inability to write correctly, resulting from a neurological or other disorder
(see also agraphia) From Greek dys – bad or abnormal + graphein – to write +
ia – indicating a condition or quality (p.225).

In the state of Texas, dysgraphia is paired with dyslexia under §504 of the Rehabilitation Act of 1973 guidelines.¹ In fact, there is no market-specified test for identifying dysgraphia as an independent disability; in the public school system, dysgraphia is identified through dyslexia testing and evaluating classroom written work. The Texas Education Agency's, *Dyslexia Handbook* (2001) lists "variable difficulty with aspects of written composition" as a characteristic that may occur with dyslexia (p.1). To be diagnosed with a writing disability, a student would have to undergo testing under special education guidelines specified by the 1997 Individuals with Disabilities Education Act (IDEA) and the testing would have to be administered by an educational licensed diagnostician.

¹ §504 of the Rehabilitation Act of 1973 establishes assessment and evaluation standards and procedures for students. Texas Education Code (TEC) § 38.003 defines dyslexia and related disorders. Texas Administrative Code (TAC) § 74.28 outlines the responsibilities of delivery of services to students with dyslexia.

Hamstra-Blotz and Blote (1993) concurred with Lerner (1983) that dysgraphia is a written-language disorder. Hamstra-Blotz and Blote (1993) further determined that the written language disorder involves mechanical writing skills. It manifests itself in poor writing performance in children of at least average intelligence who do not have a distinct neurological disability and /or an overt perceptual-motor handicap. In addition, Hamstra-Blotz and Blote (1993) advocated that the disorder appears even after a student has had proper instruction in handwriting, thus, it is not an acquired disability, but a writing disability manifesting itself in poor-quality script. They believed dysgraphia is a disability that can or cannot occur in the presence of other disabilities, like dyslexia or dyscalculia.

Dysgraphia defined by Levine (1994, 2001,2002) is simply difficulty with handwriting. Levine narrows the disorder down to fine motor problems that affect only handwriting. Under Levine's definition, dysgraphia would be addressed through physical therapy by correcting the holding position of the pencil. According to Berninger and Amtmann (2003) dysgraphia takes on a broader meaning than just poor handwriting due to fine motor skills: dysgraphia includes handwriting and poor spelling. Berninger, Rutberg, Abbott, Garcia, Anderson-Youngstrom, Brooks, and Fulton (2006) defined dysgraphia as having two skills impeded either singly or dually: only handwriting may be affected, or only spelling may be affected, or both handwriting and spelling may be affected. Berninger et al., (2006) asserts that all dyslexics have dysgraphia. The common element between dyslexia and dysgraphia is poor spelling. One explanation for possibly linking poor spelling to dysgraphia and dyslexia comes from the idea that the

retrieval of letter symbols from visual memory, typically weak in dyslexics, presents itself as a motor deterrent to rapid, automatic production of alphabet letters for the dysgraphic, thus producing poor spellers in both cases (Berninger et al., 2006).

Automatic production of alphabet letters is a lower-order writing skill that is most important in the beginning stages of writing (Berninger, Mizokowa & Bragg, 1991). For dysgraphic students, spelling may or may not be affected therefore making it possible for dysgraphics whose handwriting only is impaired not to have dyslexia (Berninger et al., 2006).

Dyslexia has gone through an evolution in its own terminology and definition. Most researchers, both in the education and neurological sciences, have narrowed the definition to a common definition adopted by The International Dyslexia Association (2002): Dyslexia is a specific learning disability that is neurological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge (Berninger, Abbot, Rogan, Reed, Abbott, Brooks, et al., 1998a; Berninger & Amtmann, 2003; Berninger, Thalberg, DeBruyn, & Smith, 1987; Brady & Shankweiler, 1991; Shaywitz & Shaywitz, 2003; Shaywitz, et. al., 1998). The dyslexia premise is that struggling non-fluent readers have difficulty attending to comprehending what they are

reading as great labor is spent on sounding out words or recognizing words. Similarly, the non-fluent writer, attending to the mechanics of writing (letter formation, letter sequencing, spelling, punctuation) in writing a composition, compromises the expression of his or her ideas and meaning, thus affecting the length, quality and clarity of the composition (Graham, 1990; MacArthur, Graham, Haynes, and DeLaPaz, 1996).

More Research Is Needed

While there is no estimate of how many children are affected by dysgraphia in the United States, the majority of students in 4th, 8th, and 12th grade demonstrated only partial mastery of writing skill demanded at their grade level on the 1998 National Assessment of Educational Progress (Greenwald, Persky, Campbell, Mazzeo, 1999) and on the 2002 National Assessment of Educational Progress (Persky, Daane, and Jin, 2003). Yet more research in the United States has been directed toward the basic psychological processes in reading and reading disabilities (Berninger et.al., 1991) and remedial strategies for reading disabilities (Shaywitz, 2003). Research in the area of writing has been focused on the psychology of writing (Bereiter & Scardamalia, 1987; Scardamalia & Bereiter, 1986; Scardamalia, Bereiter, & Goleman, 1982), which includes the composition process proposed by Hayes and Flower (1980). According to Berninger et al, (1991) as of 1991, the research on writing disabilities had not been linked to clinical diagnosis or remediation. Graham and Weintraub (1996) reviewing handwriting research from 1980 to 1994, noted that there is a need for research in the area of assessing the relationship between handwriting to other composing skills. More

exploratory studies are needed to identify the specific areas in writing that are difficult to children, when and why they occur, and their connection with overall composition generation and evaluation.

Purpose

The purpose of this study is to assess the relationship of handwriting with spelling, sentence production (referred to as T-units), and holistic scoring of essays. The data set is composed of compositions written by elementary students, grades 3 through 6. Using the Berninger et al. (2006) definition of dysgraphia, one could hypothesize that compositions with poor handwriting scores should reflect poor spelling. Likewise, compositions with a good handwriting score might reflect better spelling and more T-units, and therefore, a higher holistic score.

Research Questions

1. What relationship does handwriting have with spelling in compositions?
2. What relationship do handwriting and spelling have with the number of T-units produced in compositions?
3. What relationships do handwriting, spelling, and number of T-units in compositions have with holistic writing scores?

CHAPTER II

REVIEW OF LITERATURE

The purpose of this study was to examine the effect handwriting quality, spelling accuracy, and number of T-units have on predicting composition quality as scored on a holistic rating.

Handwriting

It is believed that transcription skills and related processes are what best differentiates good and poor writers among intellectually talented students in the elementary grades (Berninger, Cartwright, Yates, Swanson, & Abbot, 1994). If the writer's attention is occupied with mechanical concerns, the writer may find it difficult to transfer expressions and ideas to the paper that precisely fit his or her intentions at the point of translation (Berninger & Amtmann, 2003; Graham, 1990). The disruption in thought may affect the quality of the composition. Levine (1994, 2001, 2002) attributes poor handwriting to a motor process: a motor memory dysfunction, a graphomotor production deficit, or a motor feedback problem.

Motor memory dysfunction is difficulty integrating motor output with memory input (i.e., confusion in the sequence of muscle movements to make letter formation). Graphomotor production deficit is the larger muscles of the wrist and forearm being used during letter formation because they are under better control than the small muscles of the fingers – resulting in laborious and slow but legible writing. Motor feedback

dysfunction, sometimes referred to as finger agnosia, is the student having to visually monitor the location of the pencil point while making the letters. With finger agnosia, the fingers are not reporting their location back to the brain because the pencil grip may be an awkward fistlike, thumb over the other fingers position, preventing the fingers from moving the pencil efficiently to form the letters (Levine 1994, 2001, 2002).

According to Levine's definition, dysgraphia has the possibility of being corrected with proper physical therapy. Researchers (Askov, Otto, & Askov, 1970; Berninger 1999a, 2000; Berninger & Fuller, 1992; Dobbie & Askov, 1995; Graham, Struck, Richardson, & Berninger, 2006; Graham & Weintraub, 1996; Hamstra-Blets & Blote 1990, 1993; Peebles & Retzlaff, 1991; Smits-Engelsman & Galen, 1997) have long suspected a disruption in the visual and kinesthetic motor systems as possible contributors to handwriting difficulties. Poor handwriting has been described as the result of poor visual-spatial processing; poor visual-motor integration in coordinating the eye and hand movements; a deficit in the smooth coordination of the arm, hand and finger muscles; and weak fine motor skills.

Although writing can be viewed as primarily a motor process, research supports that it is a written language process as well (Berninger, 1999b; Hamstra-Bletz & Blote, 1990, 1993; Lerner, 1983). Research has shown that children who do not develop fluent transcription skills (e.g. handwriting) have difficulties with written expression (De La Paz & Graham, 1995; Graham, 1990; Graham & Harris, 2000; Graham, Harris & Fink-Chorzempa, 2000; Graham & Weintraub, 1996). Berninger, Mizokawa, and Bragg (1991) reported that a large number of children are referred to school psychologists for

writing problems, especially at and above the fourth grade level where high stakes testing begins. While handwriting is a building block for writing, Berninger et.al., (2006) caution that legible and automatic letter writing is a necessary, but not sufficient for meeting high level composition standards and passing high stakes testing in writing. In a longitudinal five year study, Hamstra-Bletz and Blöte (1990, 1993) found poor handwriting to be long term. The researchers concluded that the second graders in their study with dysgraphia had very little change with respect to handwriting structural quality in the higher grades.

Handwriting and Spelling

Moats (1995) noted that the relationship between handwriting and spelling had not been researched in any depth, and Berninger (1999b) indicated spelling to be the harder of the two to remediate. This may be as spelling utilizes decoding, phonological awareness, orthographic and morphologic knowledge, and structural analysis skills. Gentry (1982, 2000) identified five developmental stages for the acquisition of spelling: precommunicative, semiphonetic, phonetic, transitional, and conventional spelling. Ehri (1989) explains that children rely heavily on their speech production for spelling until they are exposed to written text and become more knowledgeable of how speech sounds are represented. Early spelling errors mirror the normal phonological production errors characteristic of young children's speech (Hoffman and Norris, 1989). Whether children progress through stages or phases in spelling acquisition (e.g., Varnhagen, McCallum, & Burstow, 1997), it has been shown in research that children have difficulty in auditorily

discriminating short vowels and associating them with symbols (Ehri, Wilce, & Taylor, 1987), and not mastering long vowel spellings until fourth grade (Schlagal 1989). As spellings and pronunciations are affected by the structure of more advanced morphological development (Wiig & Semel, 1980) (e.g., child/children), older children rely more heavily on the orthographical and morphological knowledge in spelling (Moats 1995; Henderson, 1980; Carlisle, 1988; Stanovich & Siegel, 1994). The need for studying spelling within composition is important as Gentry (1982, p. 182) asserted that “purposeful writing is the key to cognitive growth in spelling.”

Researchers exploring the relationship between handwriting and spelling have recognized that handwriting is not merely penmanship, but an opportunity to develop orthographic understanding of the writing system (Abbott & Berninger, 1993; Berninger, et. al., 1998b; Cunningham & Stanovich, 1990). Orthography for the purpose of this research is defined as the English sound-symbol rule system that embodies constraints on permissible letter sequences and letter uses (Venezky, 1967). This orthographic understanding may be developed through good orthographic memory skills which may involve both remembering how spoken words look when written and through the executive function of handwriting -- how it feels when writing it by hand (Hamstra-Bletz & Blote, 1990, 1993), or as explained by Moats (1995), an automatic or preprogrammed motor sequence for learned words. Orton (1966) believed poor handwriting was attributed to poor revisualization to recall letters and correct spellings of words. Graham (1990) asserts that handwriting requires orthographic knowledge and the integration of fine motor skills to produce letters and clusters of letters to form words. This is referred

to in the research as “orthographic-motor integration” (Berninger, 1994; Berninger, Yates, & Lester, 1991; Berninger, Mizokawa & Bragg, 1991; Christensen, 2004; De La Paz & Graham, 1995; Graham, 1990). Children at risk for spelling problems who also have handwriting problems have more difficulty with spelling than those who have only spelling problems (Berninger, et. al., 1998a). Thus, handwriting and spelling appear to be separable skills that may develop independently of each other in some cases, but they must be functionally coordinated for optimal translation of oral language into its written form (Berninger, 2000; Graham, Harris, & Fink-Chorzempa, 2000).

Spelling affects the quality of essays. MacArthur, Graham, Haynes, & DeLaPaz (1996) concluded that low quality of compositions may be the result of students stopping to figure out how to spell a word, which makes them forget already formulated writing ideas, or students avoiding the use of words they cannot spell, restricting the vocabulary in their writing. Further adverse affects of struggling with how to spell words may cause the writer to prematurely terminate the writing process, resulting in incomplete ideas and compositions. Strickling (1974) showed that spelling improved when legibility of compositions increased, and Graham, Berninger, Abbott, Abbott, & Whitaker (1997) found that handwriting and spelling performance accounted for a sizable portion of variance in writing quality and fluency.

Handwriting and T-units

A T-unit, as defined by Hunt (1965), is a clause with a subject and a finite verb and is grammatically capable of being terminable with a capital letter and a period. In this

study, the number of T-units was counted per composition. Previous studies have used T-units for studying syntax in a variety of ways (Beers & Nagy, 2009; Berninger & Fuller, 1992; Hunt, 1965; Sadoski & Goetz, 1998). Research has found that syntactic complexity measured by T-units (Beers & Nagy, 2009; Sturm & Rankin-Erickson, 2002) and T-unit length (Mavrogenes & Bezruczko, 1994) in relationship with quality of writing to be inconsistent. This may be the case, since Hunt's (1965) study found that 60 percent of the growth achieved by average twelfth graders, as measured by the average length of T-units, was already attained by the fourth grade, and as Beers and Nagy (2009, p.187) point out, it is the "variety of sentence structure, not complexity of sentence structure, that makes texts flow." Thus, studies that have counted the number of T-units in compositions have reported positive findings in the relationship between T-unit quantity and composition quality (Sturm & Rankin-Erickson, 2002).

Handwriting and Holistic Scoring

Holistic scoring has been around for some time and has become widely used in research (Graham, 1990; Graham & Dwyer, 1987; Graham, Schwartz, & MacArthur, 1993; Hayes, Hatch, & Silk, 2000; Hillocks, 1986). Holistic scoring considers variables such as content, organization, vocabulary and mechanics, as variables that T-units, alone, would not be able to determine. Two earlier studies, Markham (1976), and Marschall and Powers (1969) confirmed the relationship between handwriting and writing quality. However, there is little research that has examined the quality of compositions in relationship to spelling accuracy or handwriting implications on producing accurate

spelling and T-units in compositions. More research is needed on the relationships between transcription variables and holistic scores.

CHAPTER III

METHOD

Compositions have been analyzed and used for research in analyzing writer behaviors. Compositions have been analyzed for writer thought processes and competencies, but also for writer deficiencies (e.g., poor spelling, poor handwriting, emotional disturbances). Compositions can be analyzed from a “text-based” approach (Spandel, 2004) or from a “writer-based” approach (Stahl, 1977; Bereiter, 1980). Stahl (1977) used the “writer-based” approach to determine the knowledge of writing conventions, processes, and cognitive strategies of students grade 2 through 8 by examining the structural characteristics of compositions. Spandel (2004) analyzed compositions from the “text-based” approach recording reappearing characteristics in which she would later call “traits of writing.” The approach in this research is a “text-based” approach quantifying word counts and T-units, and qualifying handwriting and overall impression.

Participants

The compositions used for this study come from a previous study by Sadoski, Willson, and Norton (1997). After conducting a teacher summer writing institute for improving composition instruction, the research team solicited 16 classroom teachers and their 275 students from 6 public school districts in various locations in Texas to submit compositions for analysis. The participants in the study represented grades 1, 3, 4, 5, 6, and 8. There were no special education or gifted and talented classes included in the

study, but the students participating reflected the broad variation in ability that occurs in typical public school classrooms. Anonymity for teachers, students, schools, and school districts was guaranteed. For more information concerning the results of the study see Sadoski, Willson, and Norton (1997).

Procedure

During the first week of school, the teachers used standardized conditions adapted from the National Assessment of Educational Progress (NAEP) in writing. The writing prompt for grades 3 – 6 elicited informative writing from personal experience. The students were asked to “Tell about a favorite story so that someone who has not read it will understand what happened,” taken from Applebee, Langer, Jenkins, Mullis, and Foertsch (1990, p.62). Students were allowed 30 minutes to complete the task. Teachers were given instructions to go over the directions with students and to adhere closely to the time limits while allowing students time to finish a sentence. The schools mailed their students’ compositions upon completion.

This study analyzed the handwriting, spelling, T-units, and holistic scoring of the compositions from grades 3, 4, 5 and 6 which totaled 223 compositions. The sample consisted of 38 compositions from two teachers in grade 3, 48 compositions from three teachers in grade 4, 97 compositions from five teachers in grade 5, and 40 compositions from two teachers in grade 6. Handwriting quality, spelling accuracy, and number of T-units were analyzed for their relationships with the composition’s holistic score using path analysis.

Handwriting and Holistic Scoring

The handwriting score and the composition holistic score had been previously scored by graders in the Sadoski et al. (1997) study. The compositions were rated by eight graduate students, who were pursuing advanced degrees in language arts education and were taking a course in the teaching of writing. Sadoski, et al. (1997) reported that the raters worked in teams of two. The handwriting scale was used reliably by Chall, Jacobs, and Baldwin (1990). It provided a rating scale of 0 – 3. (See Appendix A for Handwriting Scale). The holistic scoring scale (Spandel & Stiggins, 1990) ranged from 0 to 5 and encompassed content, organization, voice, word choice, sentence fluency, and conventions. (See Appendix B for holistic scoring system.) Examples and explanations for assigning various scores were provided with this system to the raters.

Each team was given a randomly selected subset of compositions for each grade level. Ten percent of each subset was randomly selected to check for inter-rater reliability on two criteria:

- 1) Pairs of scores could be no more than one point apart. This criterion was achieved at 100% for handwriting scores on a 3 point scale, and at 98.5% for the quality score on a 6-point scale.
- 2) Inter-rater correlations between independent scorings must reflect at or above $r = .80$. This criterion was achieved at $r = .84$ for handwriting and $r = .80$ for quality scores.

When these two criteria had been achieved, the teams scored the remaining compositions independently, conferring with each other only when presented with serious doubt about their scoring (Sadoski et al., 1997, p. 129).

Spelling

Spelling was scored as a percentage of accurately spelled words per number of words in the composition minus proper nouns. The decision not to include proper nouns in the total number of words per essay was to forego any penalty on the students using proper nouns such as unusual character names and names of places in books. Such proper nouns occurred frequently in response to the writing prompt to retell a story. This decision to not include proper nouns has been used in prior studies focused on analyzing spellings in compositions (e.g. MacArthur et al., 1996; Berninger, Abbott, Abbott, Graham, & Richards, 2002). Other conditions made in determining accuracy of spelling consisted of the following two: compound words written as two separate words but spelled accurately were counted as correct; and homonyms, used in the wrong context, were counted as misspelled words (i.e., the word was spelled incorrectly for the context.)

T-units

The number of T-units in each composition was counted. A doctoral student with twenty years of teaching experience in elementary schools was trained by the researcher in T-unit analysis. Training involved the researcher and the doctoral student working collaboratively counting T-units on elementary student writing samples not in the study.

The researcher and doctoral student then each scored 23 (10 %) randomly selected papers from those used in the study for number of T-units, achieving an inter-rater reliability of $r = .99$.

Data Analysis

Path analysis was used to study the relationships among the variables. The causal model is a theoretical ordering of variables in terms of their effects on other variables (Braxton, Duster, & Pascarella, 1988). Path analysis examines the direct and indirect effects of independent variables hypothesized as causes of dependent variables (Pedhazur, 1982; Cohen, Cohen, West, & Aiken, 2003). This procedure provides a more accurate understanding of the complexity of the relationships than simple correlations. The general procedure consists of performing multiple linear regressions of each step in the path model and using the beta weights as path coefficients. The total effect, called the effect coefficient, is equal to the direct effect of the variable plus any indirect effects (Pedhazur, 1982). Alpha was set at the .05 level.

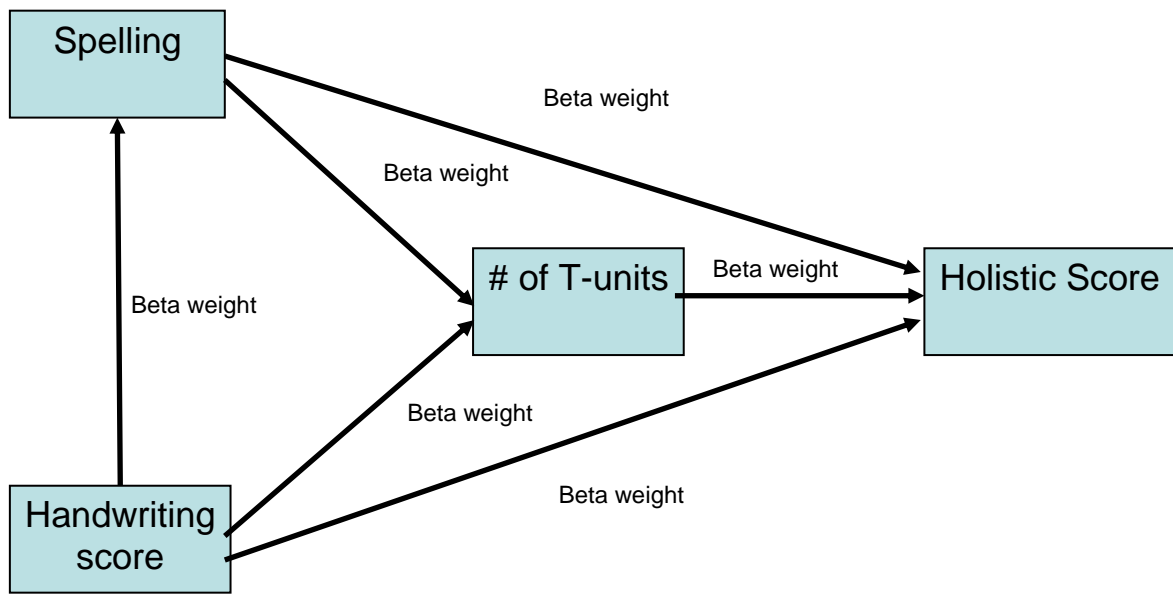


Figure 1 Path model for testing dysgraphia

Figure 1 represents the pattern of causal relations among the variables. The straight lines represent the direct effect of the variable, or the path coefficients (beta weights).

CHAPTER IV

RESULTS

Path analysis was used to study the relationships among the variables handwriting, spelling, T-units, and holistic scoring and to evaluate a theoretical model of dysgraphia. The data were tested and analyzed with multiple linear regression and path analysis procedures using SPSS. The model was analyzed by grade level to investigate possible developmental trends.

Third Grade

The descriptive statistics for all the measures of third grade are given in Table 1 and bivariate correlations are given in Table 2. The results of the path models of the relationships among the variables for third grade are given in Figure 2. The effect coefficients, the sum of the direct and indirect coefficients, are in Table 3. There was no statistically significant relationship of spelling and handwriting for third grade. There was a statistically significant beta of spelling in predicting number of T-units, but not handwriting. The handwriting score (beta = .39) and number of t-units (beta = .56) were statistically significant in predicting the holistic score.

Table 1 Means and standard deviations for holistic score, handwriting score, T-units, and spelling in grade 3 essays (N = 38)

Variable	M	SD
Holistic score	2.42	.89
Handwriting score	1.97	.49
T-units	10.68	6.58
Spelling	.85	.09

Table 2 Bivariate correlations of holistic scoring, handwriting scoring, T-units, and spelling for grade 3 essays

Variable	Holistic score	Handwriting score	T-units	Spelling
Holistic score	1.00	.52***	.57***	.02
Handwriting score		1.00	.17	.22
T-units			1.00	-.37**
Spelling				1.00

* $p < .05$, ** $p < .01$, *** $p < .001$

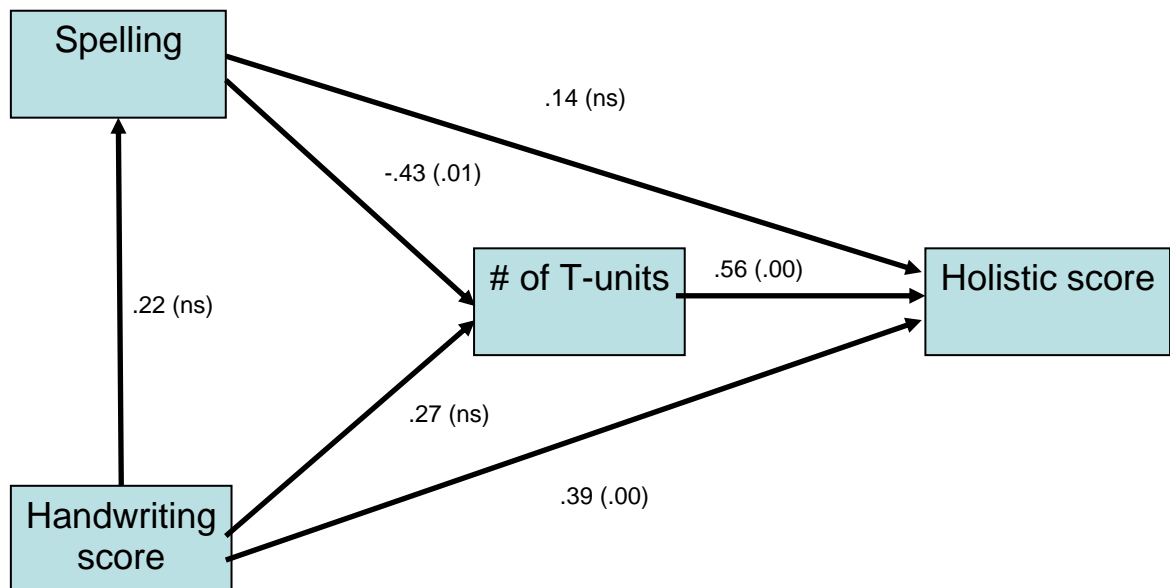


Figure 2 Path model for grade 3

Table 3 Effect coefficients for predictors in path model for grade 3

Dependent variable	Independent variable	Effect coefficient
Spelling	Handwriting	.22
	Handwriting	.18
# of T-units	Spelling	-.43
	Handwriting	.52
Holistic score	Spelling	-.10
	# of T-Units	.56

Fourth Grade

The descriptive statistics for all the measures of fourth grade are given in Table 4 and the bivariate correlations are given in Table 5. The results of the path model of the relationships among the variables for fourth grade are given in Figure 3. The effect coefficients, the sum of the direct and indirect coefficients, are in Table 6. In fourth grade, the relationship of spelling and handwriting was not statistically significant and both spelling and handwriting had no effect on predicting number of T-units. Only number of T-units had statistical significance in predicting the holistic score.

Table 4 Means and standard deviations for holistic score, handwriting score, T-units, and spelling in grade 4 essays (N = 48)

Variable	M	SD
Holistic score	2.54	.82
Handwriting score	2.06	.25
T-units	11.94	5.87
Spelling	.91	.08

Table 5 Bivariate correlations of holistic scoring, handwriting scoring, T-units, and spelling for grade 4 essays

Variable	Holistic score	Handwriting score	T-units	Spelling
Holistic score	1.00	.15	.48***	-.16
Handwriting score		1.00	.08	.02
T-units			1.00	.08
Spelling				1.00

* $p < .05$, ** $p < .01$, *** $p < .001$

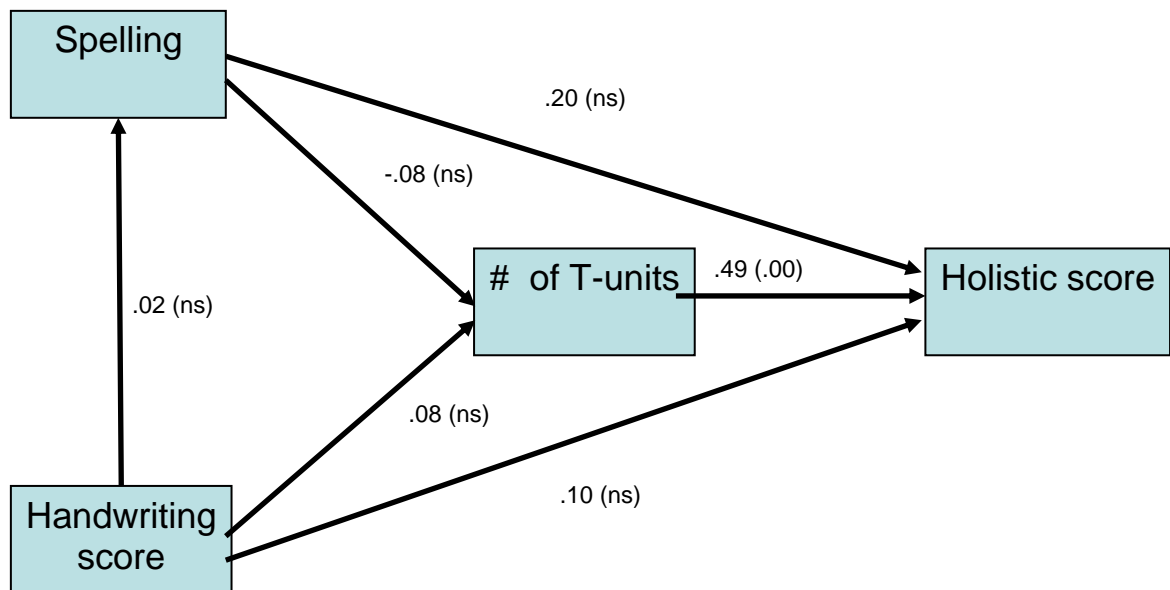


Figure 3 Path model for grade 4

Table 6 Effect coefficients for predictors in path model for grade 4

Dependent variable	Independent variable	Effect coefficient
Spelling	Handwriting	.02
# of T-units	Handwriting	.08
	Spelling	-.08
Holistic score	Handwriting	.14
	Spelling	.16
	# of T-Units	.49

Fifth Grade

The descriptive statistics for all the measures of fifth grade are given in Table 7 and the bivariate correlations are given in Table 8. The results of the path model of the relationships among the variables for fifth grade are given in Figure 4. The effect coefficients, the sum of the direct and indirect coefficients, are in Table 9. For fifth grade, handwriting produced a small statistically significant relationship with spelling (beta= .29), and another in predicting number of T-units (beta = .31). Spelling (beta = .33) and number of T-units (beta = .51), but not handwriting, were statistically significant in predicting holistic scoring.

Table 7 Means and standard deviations for holistic score, handwriting score, T-units, and spelling in grade 5 essays (N = 97)

Variable	M	SD
Holistic score	2.43	1.12
Handwriting score	2.01	.27
T-units	15.76	8.08
Spelling	.93	.08

Table 8 Bivariate correlations of holistic scoring, handwriting scoring, T-units, and spelling for grade 5 essays

Variable	Holistic score	Handwriting score	T-units	Spelling
Holistic score	1.00	.36***	.60***	.46***
Handwriting score		1.00	.35***	.29**
T-units			1.00	.20*
Spelling				1.00

* $p < .05$, ** $p < .01$, *** $p < .001$

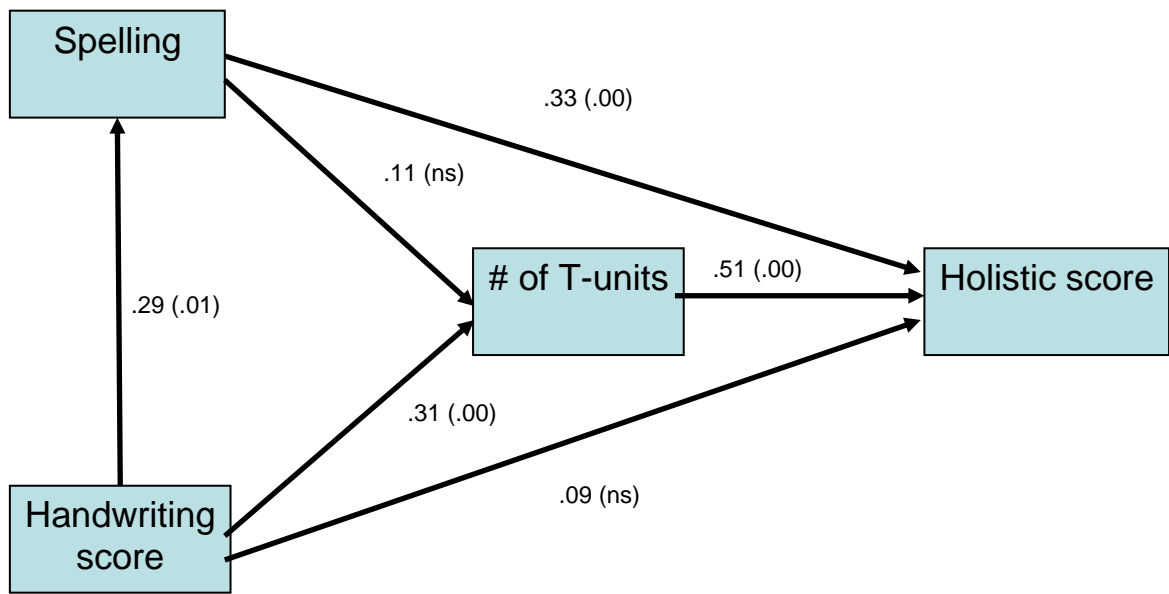


Figure 4 Path model for grade 5

Table 9 Effect coefficients for predictors in path model for grade 5

Dependent variable	Independent variable	Effect coefficient
Spelling	Handwriting	.29
# of T-units	Handwriting	.34
	Spelling	.11
Holistic score	Handwriting	.36
	Spelling	.39
	# of T-Units	.51

Sixth Grade

The descriptive statistics for all the measures of sixth grade are given in Table 10 and the bivariate correlations are given in Table 11. The results of the path model of the relationships among the variables for sixth grade are given in Figure 5. The effect coefficients, the sum of the direct and indirect coefficients, are in Table 12. In sixth grade, handwriting had a statistically significant coefficient in predicting spelling (beta = .64), but only spelling was statistically significant in predicting number of T-units (beta

= .49). Both T-units (beta= .52) and spelling (beta=.33) were statistically significant in predicting holistic scores.

Table 10 Means and standard deviations for holistic score, handwriting score, T-units, and spelling in grade 6 essays (N = 40)

Variable	M	SD
Holistic score	2.25	1.24
Handwriting score	1.95	.32
T-units	17.25	11.63
Spelling	.95	.06

Table 11 Bivariate correlations of holistic scoring, handwriting scoring, T-units, and spelling for grade 6 essays

Variable	Holistic score	Handwriting score	T-units	Spelling
Holistic score	1.00	.30 *	.65***	.54***
Handwriting score		1.00	.14	.64***
T-units			1.00	.38**
Spelling				1.00

* $p < .05$, ** $p < .01$, *** $p < .001$

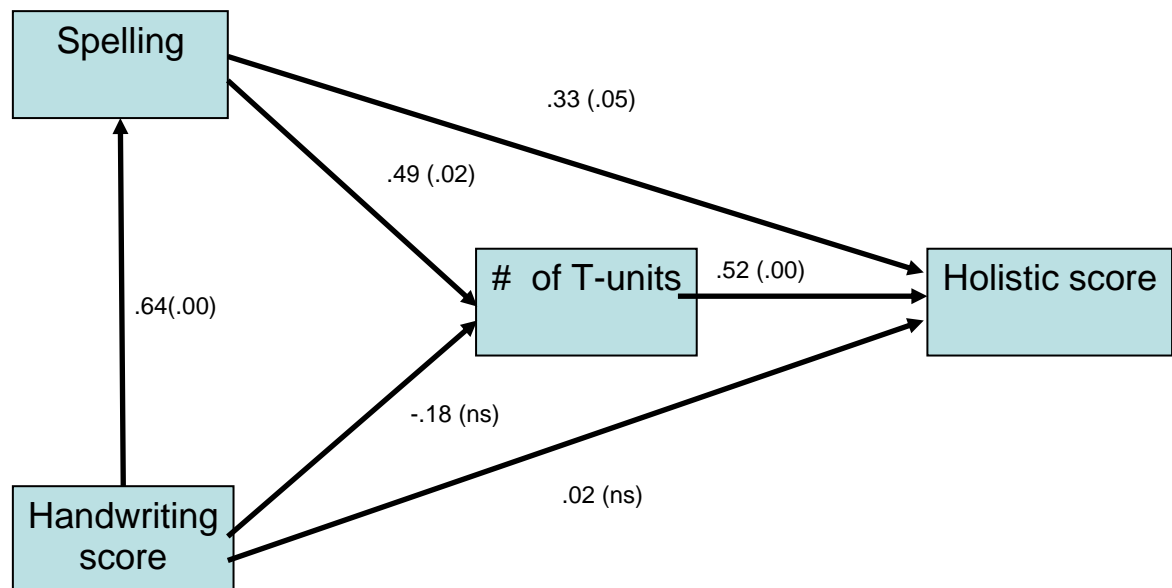


Figure 5 Path model for grade 6

Table 12 Effect coefficients for predictors in path model for grade 6

Dependent variable	Independent variable	Effect coefficient
Spelling	Handwriting	.64
	Handwriting	.13
# of T-units	Spelling	.49
Holistic score	Handwriting	.30
	Spelling	.58
	# of T-Units	.52

CHAPTER V

DISCUSSION AND CONCLUSION

This study attempted to propose and test a causal model for finding the effects of handwriting on holistic scoring of essays. Path analysis was used to examine the predictability of dependent variables on independent variables. The study attempted to answer three questions:

1. What relationship does handwriting have with spelling in compositions?
2. What relationship do handwriting and spelling have with the number of T-units produced in compositions?
3. What relationships do handwriting, spelling, and number of T-units in compositions have with holistic writing scores?

To help in determining developmental trends, Table 13 shows the effect coefficients for each grade for each path relationship. For purposes of discussion, the effect coefficients will be compared to effect sizes according to Cohen's *d* (1988) criteria of small (.20), medium (.50), and large (.80). Cohen and Hyman (1979) recommend the reporting of effects even when the results are not statistically significant, for observing the magnitude or direction of the effect.

Table 13 Effect coefficients by path and grade level

Paths	Grade 3 N = 38	Grade 4 N = 48	Grade 5 N = 97	Grade 6 N = 40
HW to Spelling	.22	.02	.29	.64
HW to T-units	.18	.08	.34	.13
HW to Holistic	.52	.14	.36	.30
Spelling to T-units	-.43	-.08	.11	.49
Spelling to Holistic	-.10	.16	.39	.58
T-units to Holistic	.56	.49	.51	.52
HW = handwriting score, Holistic = holistic scoring				

Handwriting to Spelling

Question One involved the relationship between handwriting and spelling. This question has not been well researched. Berninger, Abbott, Abbott, Graham, and Richards (2002) examined compositions of students in grade one through six for spelling accuracy and found a significant covariance between handwriting and spelling in only grades one and three. The researchers suggested from this outcome that handwriting and spelling skill may develop independently from each other.

According to Cohen's (1988) criteria, this study yielded a small effect coefficient between handwriting and spelling in grades 3 and 5 and a medium effect coefficient in grade 6, suggesting that handwriting may take on more importance as motor patterns of spelling words and knowledge of orthography begin to merge in production in the later years. This is called orthographic-motor integration (De La Paz & Graham, 1995). The 4th grade data yielded a very small effect between handwriting and

spelling possibly because the 4th grade handwriting scores had little variance (i.e. 45 out of 48 papers were rated a 2 on the handwriting scale). These results suggest that handwriting and spelling may develop separately early on, but merge in later development.

Handwriting and Spelling and T-units

The purpose of Question Two was to determine whether handwriting or spelling affect the production of T-units. The handwriting path to T-units consisted of direct and indirect paths. In handwriting, grade 5 had a small effect coefficient, according to Cohen's (1988) criteria, in relation to T-units, while the other grades had even smaller effect coefficients. Handwriting appears to have little effect on the production of T-units.

Spelling, as a direct path, yielded a negative medium effect coefficient in 3rd grade and a positive medium effect coefficient in 6th grade in predicting T-units. The Berninger et al., (2002) study found spelling to be a constraint on how much a student composed in grades 1, 3, and 4. This was not the case for this study. The third grade effect coefficient suggests that misspellings did not constrain the third graders in producing T-units, and in the 6th grade, the opposite occurred: the better the spelling accuracy, the higher number of T-units produced. A possible explanation may be the difference in age level and spelling development (Gentry, 1982). The third graders may not be inhibited in making spelling errors as they may be at the "transitional" stage in spelling where they are just beginning to utilize the basic conventions of orthography,

and at the same time, they are beginning to write for meaning which entails writing more T-units. On the other end, sixth graders may be in the “conventional spelling” stage of spelling development where the knowledge of the English writing system is now firmly established. By sixth grade, students understand the importance of spelling accuracy in written responses, and those who are good spellers may possess a better self-efficacy towards spelling and writing and write more (Rankin, Bruning, Timme, & Katkanant, 1993).

Predicting Holistic Score

Question Three involved the predicting of holistic scores by handwriting, spelling, and number of T-units.

Handwriting. According to Cohen’s (1988) criteria, handwriting presented a medium effect coefficient in 3rd grade (.52) in relationship to holistic scoring. The handwriting effect coefficients in grade 5 (.36) and 6 (.30) were small in relationship to holistic scoring. While handwriting was generally weak in its relationship to T-units, it shows a stronger relationship with the overall score of the compositions. This may be due to rater bias toward compositions with neat handwriting and correct spelling. The importance of transcription skills at the intermediate grades was also noted in the Graham et al., (1997) study which cited handwriting as accounting for 45% of the variability in writing quality.

Spelling. Spelling accuracy in the compositions presented a progressive increase in relationship to holistic scoring from grade 3 to grade 6. The effect

coefficient went from negative (-.10) to positive (.16) to positive and small (.39) to positive and medium (.58). This finding may indicate that spelling becomes more important in the higher intermediate grades because as the writer develops in age, so does the expectation to spell more accurately. These findings are supported by the Berninger et al., (2002) study, which found accurate spelling to contribute to how well the students scored on composition quality in grades 1, 2, and 3.

T-units. In all four grades, the number of T-units yielded medium effect coefficients for holistic scoring. This finding aligns with the composition literature reviewed by Hillocks (1986) and with other studies analyzing student written compositions which discovered that the length of essays was generally associated with the holistic scores of essays (e.g., Beers & Nagy, 2009).

Limitations of This Study

One limitation of the study is that the data sample was at the convenience of teachers who willingly participated and whose students chose to write. Another limitation on this sample of essays is that the essays did not offer very much variation on handwriting scores, especially at grade 4. Another limitation is that assessing handwriting legibility, spelling, number of T-units, and composition quality consisted of global measurements, which were not highly refined or analytical. More research using random samples and more refined assessments may yield different results.

Conclusion

Overall, this study attempted to assess the effect of handwriting on spelling, T-unit production and holistic scoring of essays. This study supported previous research which concluded that the longer the composition length, the more likely the composition would receive a higher holistic score. The causal model suggests that handwriting affects spelling which affects the number of T-units written which affects the outcome of the holistic score of the composition. Through various paths, handwriting appears to be directly and indirectly having some effect on composition quality. Dysgraphia defined as poor handwriting has a domino effect on composition writing. Poor handwriting may influence poor spelling which in turn affects the production of sentences which affects the length of the composition. Shorter compositions, poor spelling, and illegible handwriting receive the same outcome – poorer scores.

Implications

If poor handwriting is ignored in the early grades, it may cause more serious writing problems for the student in the upper grades. Poor handwriting is analogous to Stanovich's (1998) "Matthew-effect" toward reading instruction, where small differences in reading ability in the early grades grow to become large gaps by the middle and upper grades. Overlooking or dismissing a student's poor handwriting in the early grades with the perception that handwriting is developmental (i.e. the student will develop better fine motor control as he gets older), may lead this student to becoming a poor writer, or develop written expression difficulties in later years. Hamstra-Bletz and

Blöte (1990, 1993) noted in their five year longitudinal study that handwriting for dysgraphics had little change from second grade. Handwriting for dysgraphics become set by this age, therefore, it is important to identify students in the earlier grades who need correction in their pencil grip holds and/or motor memory formation of letters. Handwriting instruction begins as early as Pre-Kindergarten when children begin coloring and writing their names.

Future studies need to be longitudinal in documenting the writing changes a dysgraphic student experiences from early elementary through adolescence and the affects dysgraphia has on the emotional well being of the child as well as his/her self-efficacy in writing. Studies are needed to address the recommendation for choice of script, (i.e. manuscript or cursive) for students with poor handwriting. More research is needed on deciding if keyboarding is an effective tool for dysgraphics or just another medium. Does the disruption in handwriting automaticity transfer to keyboarding? Does keyboarding help to ward off other written expression difficulties or do students with dysgraphia have a combination of written expression problems? Most importantly, dysgraphia needs to be separated from dyslexia as its own disability. As Reed (1981) observed, reading and writing are not inverses of each other. More studies are needed in identifying and examining dysgraphic students and finding the common characteristics among them. Future studies exploring the connection between handwriting and spelling, and handwriting and written expression in spontaneous, composition writing would help classroom teachers better serve the student struggling with written expression.

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APPENDIX A

Handwriting Score (1 = lowest, 3 = highest)

1 = illegible handwriting, characterized by inconsistent spacing and irregularly shaped letters, that is hard to decipher

2 = legible handwriting

3 = neat, stylized, attractive handwriting

Chall, J, Jacobs, V., & Baldwin, L. (1990). The reading crisis: Why poor children fall behind (p.60). Cambridge, MA: Harvard University Press.

APPENDIX B

Write a number in the blank below. Use the 0 – 5 scale as described by Spandel & Stiggins. A score of 0 should be used only for papers that are blank or incomprehensible. Try to score the paper even if it has barely legible handwriting or does not seem to deal with the assigned topic.

Spandel, V., & Stiggins, R. (1990). *Creating writers: Linking assessment and writing instruction* (pp.xi-xii). New York: Longman.

VITA

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